

Weighted Paper Bridge

Duration	Age	Difficulty
45-60 min	17-18	Medium
#PaperBridge #STEAMbrace #CreativeEngineering		

DESCRIPTION

This activity challenges students to build a bridge using only A4 sheets and tape, which can support the greatest possible weight. Through the challenge, participants explore forces, balance, proportion and measurement. Creativity, iterative design, teamwork, gender equity and female visibility in STEAM are promoted.

KEY COMPETENCES (EU)

- Mathematical competence and basic skills in science and technology
- Digital competence
- Social and civic skills
- Spirit of initiative and entrepreneurship
- Cultural awareness and gender expression

ACTIVITY OBJECTIVES

1. Understand the basic principles of forces and balance applied to structures.
2. Apply proportions, estimates and measurements during planning and execution.
3. Develop creative thinking and strategies efficient design.
4. Work as a team, promoting gender-balanced leadership.
5. Recognize the contribution of women in engineering and architecture.
6. Use visual representation to communicate results and ideas.

MATERIALS



Pencils



Ruler



(optional to document the process) Mobile devices

- Provided by students
- Provided by the teacher/institution
- Downloadable Elements





A4 sheets (minimum 10 per group)



Tape



Scissors



Heavy books (to simulate the weight on the bridge)



Stopwatch



[Dimensions and weights registration sheet](#)



[Poster with models of famous bridges](#)



[Mini-biographies of female engineers such as Emily Roebling or Zaha Hadid](#)

PREVIOUS PREPARATION

Divide into groups with rotating roles (including female leadership encouraged) Show images of real and artistic bridges

Present biographies of women in engineering/architecture

Distribute registration form

Trigger question: "What if you had to cross a river with a bridge you made?"

CONTEXTUALIZATION AND ADAPTATION

Initial question: What if the only way to cross a river was a bridge built by you, out of paper?

Students are invited to reflect on the role of bridges in society, how they connect cities, people and cultures.

You can explore iconic bridges such as the Vasco da Gama Bridge or the Golden Gate, as well as handcrafted bridges made from natural materials.

 **Optional video:** "The Most Famous and Incredible Bridges in the World" (YouTube)

 **Previous activity:** Draw the strongest bridge possible using only straight lines (1 min, no journal).

Watch video  - "The Most Famous and Incredible Bridges in the world"

★ Link: <https://www.youtube.com/watch?v=IDIGH3JoGns>





Classroom activity

In small groups, students are given the challenge of building a bridge using only A4 paper and tape. Before starting, they discuss: “What makes a bridge stable and resistant?”; “How can we ensure balance with the minimum amount of material?”

Each group designs their design, builds the bridge and tests how much it can withstand before collapsing. They then share their chosen design, the results and explain their structural decisions with the class.

Note for the teacher

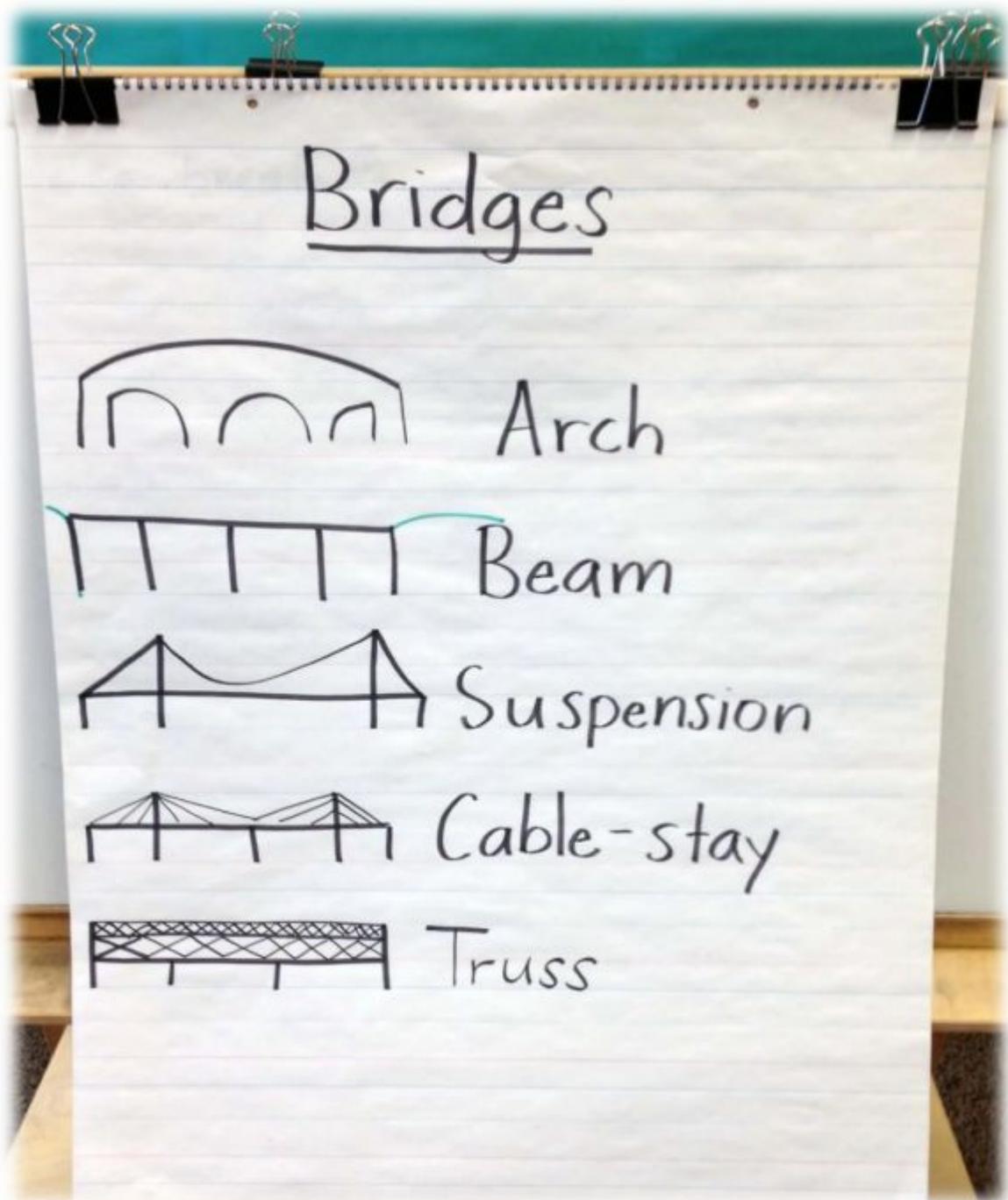
Ensure that all students, especially girls, actively participate in both technical tasks and leadership roles. This approach promotes inclusion, combats stereotypes, and reinforces gender equity in STEAM activities.



ACTIVITY

Planning (10 min)

Objective: Apply engineering and mathematical principles on paper before construction.

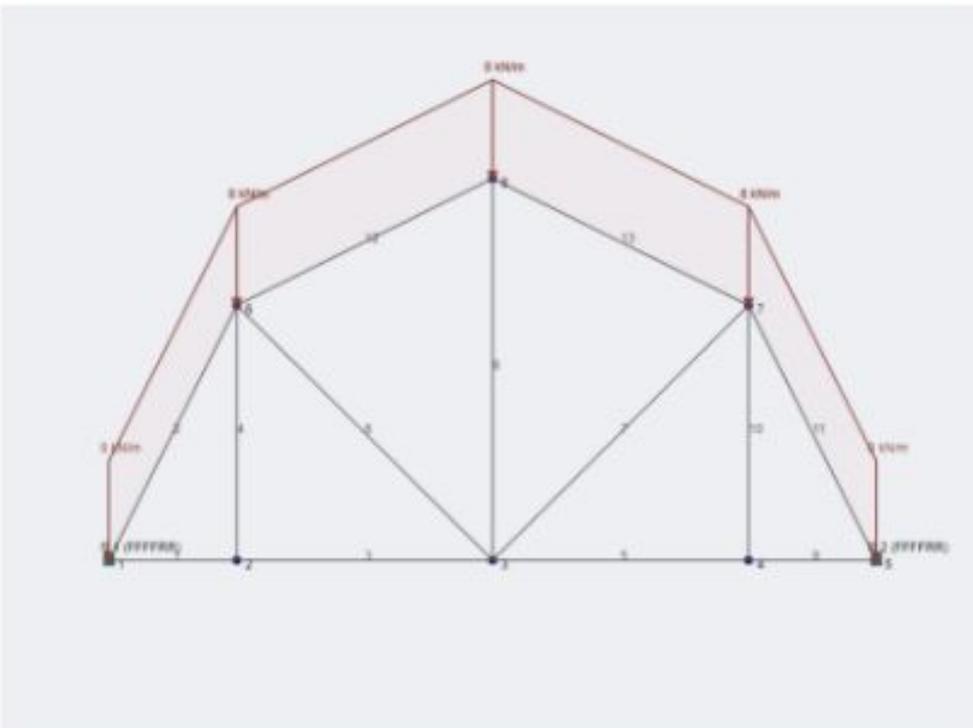
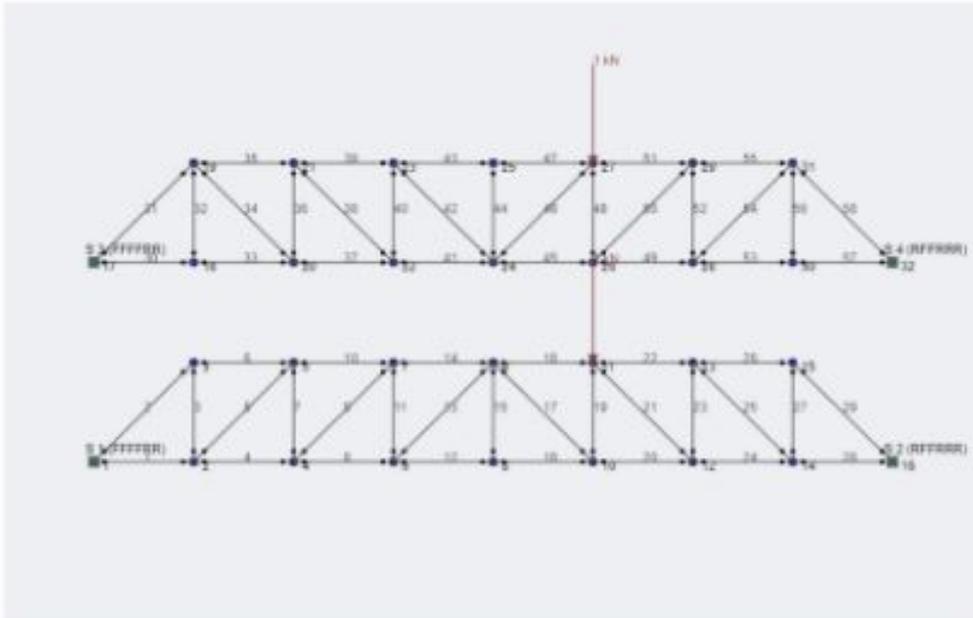




- ✓ Each group analyzes images of real bridges (reference poster) using the "Bridges that connect the World" worksheet as a reference.



- ✓ Choose the "truss bridge" model as a base.
- ✓ Draw a technical sketch of the bridge with estimated proportions (length, height, width) and use the "Weighted Paper Bridge" Recording Sheet to enter the estimated dimensions and proportions.





✓ Calculate the weight distribution and define where to apply reinforcements. The groups analyze their structure to plan the weight distribution and identify the points that need reinforcement.

Each segment of the bridge (base, center, sides) is described in terms of dimensions and structural function. The analysis should consider where the weight will be most concentrated and where there is the greatest risk of collapse, such as the center of the bridge or the side joints.

The center tends to support the greatest vertical load, while the bases and sides help maintain lateral balance. You should use the grid to estimate how much weight each part could support. To do this, consider the dimensions (width, height, length) and whether or not reinforcements are applied.

You can use a simple estimation formula for the weight supported by each segment:

$$\text{Supported Weight (g)} \approx \text{Base Area (cm}^2\text{)} \times \text{Height (cm)} \times \text{Reinforcement Factor}$$

Use the Excel model "Calculating weight distribution" to perform this task.

FORMULAS TO USE

$$\text{Base Area} = \text{Length} \times \text{Width}$$

$$\text{Structural Volume} = \text{Length} \times \text{Width} \times \text{Height}$$

$$\text{Estimated Load} = \text{Base Area} \times \text{Height} \times \text{Reinforcement Factor}$$

Reinforcement Factor: 1 (none), 1.5 (light), 2 (strong)

$$\text{Efficiency} = \text{Estimated Load} \div \text{Structural Volume}$$

Example:

A 10 cm × 4 cm and 5 cm high base with light reinforcement:

$$\rightarrow \text{Weight} \approx (10 \times 4) \times 5 \times 1.5 = 300 \text{ g}$$



This formula is just an approximation for thinking structurally. You don't need to be exact, but you should compare values between segments: which one holds the most? Which one is the weakest? These estimates will help you decide where to reinforce and which areas are likely to collapse first. Use these calculations to justify your choices in the grid and better prepare for the final performance of the bridge.

✓ **Integrate visual aspects inspired by cultures or symbols of unity and diversity.**

Each group is challenged to incorporate visual elements that represent different cultures, values, or symbols of unity into their bridge design. This could include traditional patterns, colors with symbolic meaning (such as peace, balance, or resistance), or even shapes inspired by architecture from different regions of the world.

✓ **Name the bridge after a female engineer (e.g. Zaha Hadid Bridge).**

To promote recognition of the role of women in STEAM, each group should name their bridge after a female engineer, architect or inventor who has made significant contributions to science, engineering or design. Examples include Zaha Hadid, Emily Roebling or Ellen Swallow Richards. The choice should be informed by a little research into who the person was and their impact.

✓ **Share roles within the group, promoting female leadership.**

During the construction of the bridge, students must distribute tasks such as planning, designing, cutting, assembling and communicating. In the process, the group is encouraged to ensure that one of the girls in the group (when applicable) takes on a leadership or coordination role, as a way of balancing opportunities and developing skills in collaborative contexts.



Construction (20 min)

1. Materials needed

- 10 A4 sheets- Scissors- Adhesive tape- Pencil and ruler- Cardboard (optional)

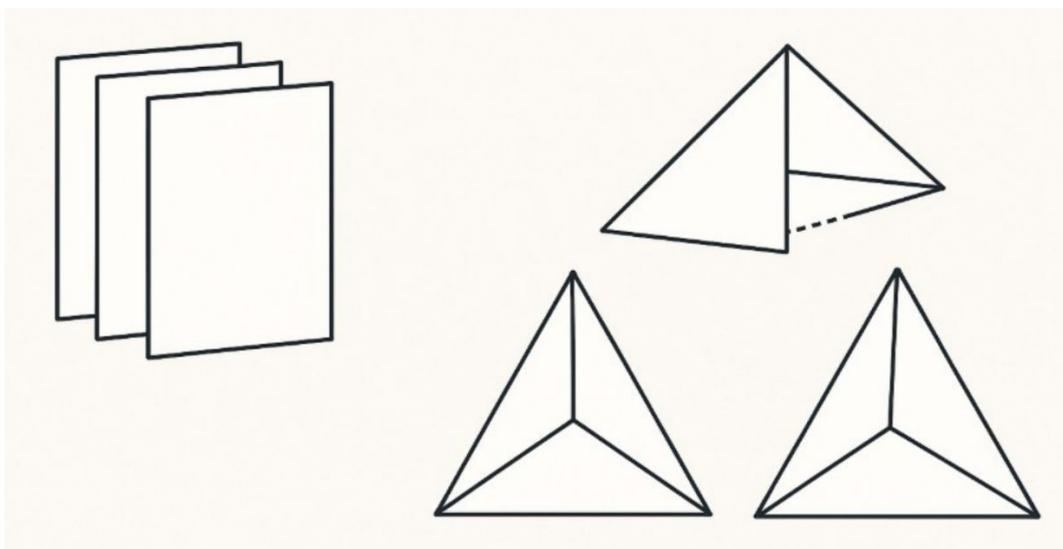
STEPS

1 - Roll 4 sheets to form strong tubes (they serve as a base or longitudinal beams).

Efficient use of paper is essential: folding is stronger than stacking, and distributing the weight well increases durability.

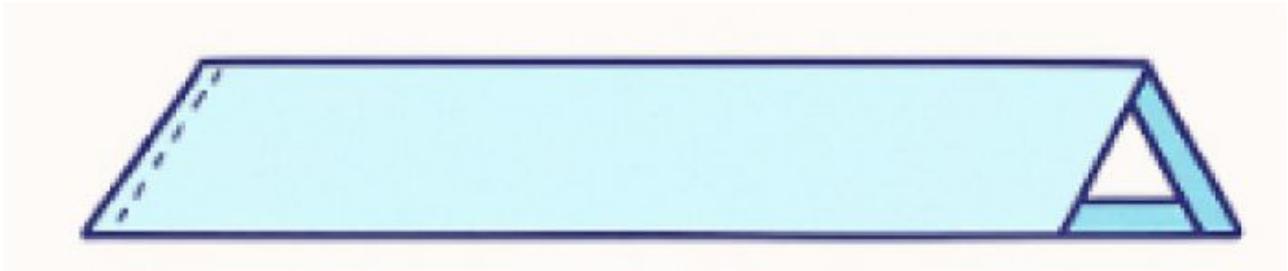


2 - With 4 sheets, create folded triangles (internal diagonal structures).





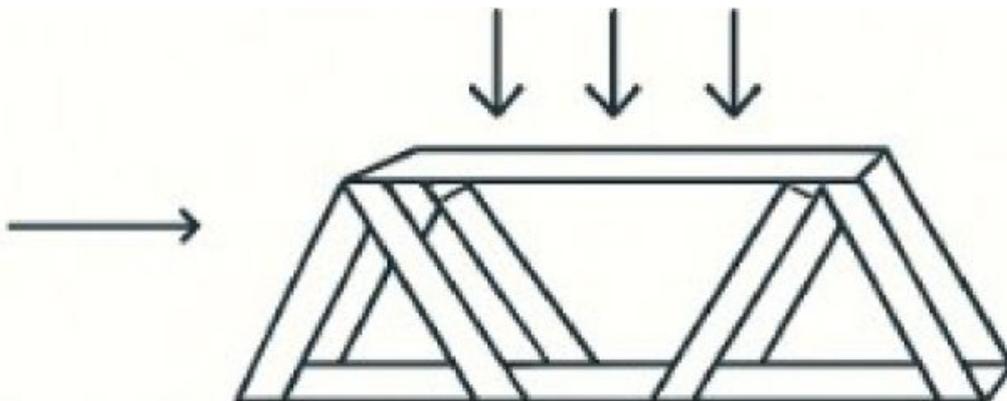
3 - Use 2 sheets for the central board where the weights are applied.



4 - Join all the parts with tape, ensuring symmetry.

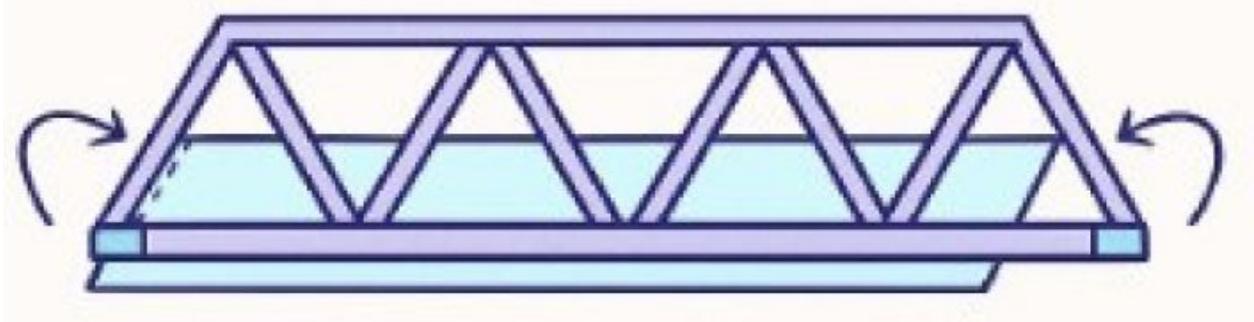


5 - Observe the most vulnerable areas (center and lateral joints).

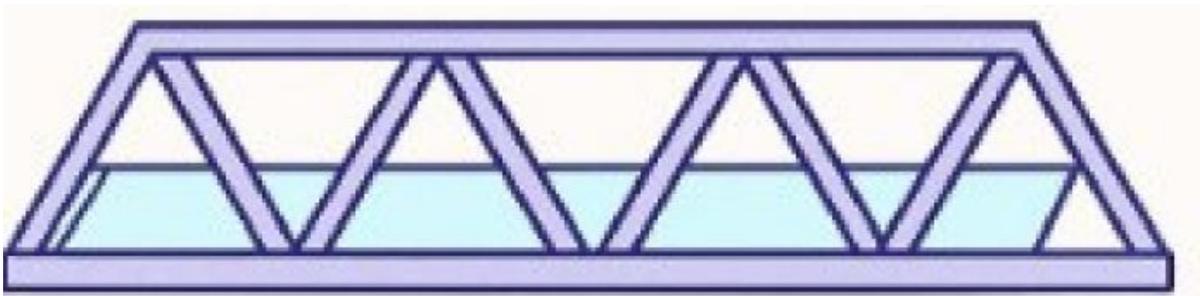




6 - Add strips of cardboard or folded paper to the joints.



7 - Ensure that the triangular trusses are well distributed.



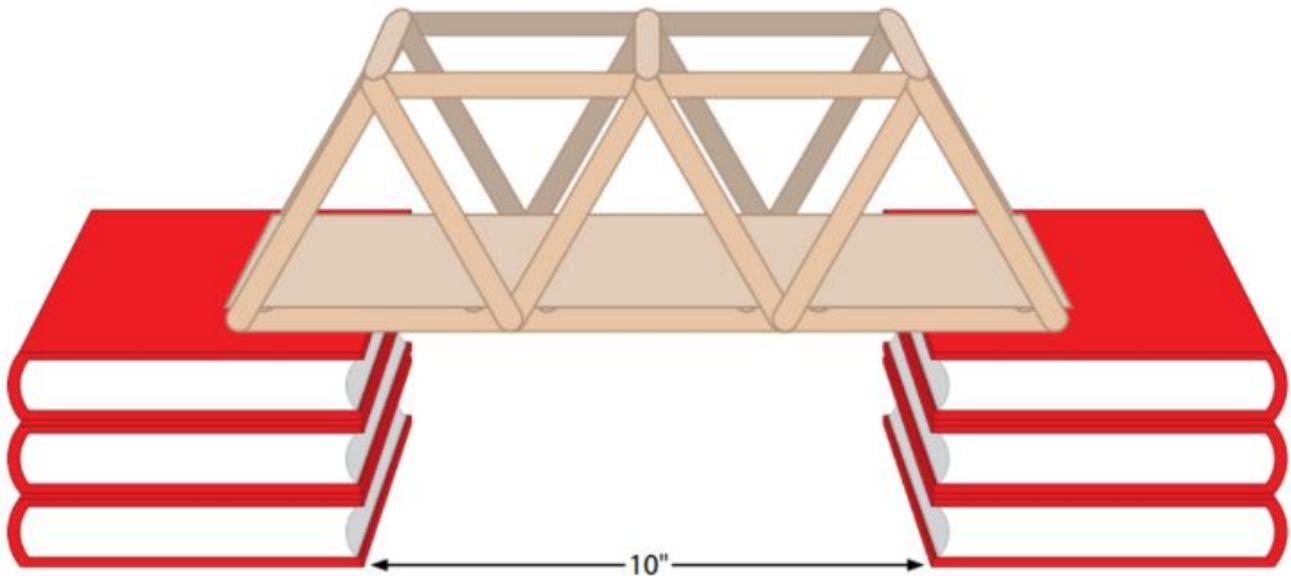
8 - Add the name of the bridge in honor of a female engineer and integrate colors and cultural or unity symbols into the structure.





Testing and evaluation (15 min)

1. Each bridge is placed between two books for support.



2. Books are added or weights progressively until the structure collapses.

Registration form

1. Group name
2. Dimensions (length, width, height)
3. Weight supported
4. Stability assessment
5. Observations



CONCLUSION AND SHARING

1. After presenting the bridges, lead a final reflection with the entire group:

- Which bridge was more effective?
- Which was more creative?
- What would you improve?



2. Then, it promotes the sharing of work:

- Encourage students to take photos and share them on the school's social media with the hashtags: #PontesDePapelSTEAM
- Optionally, students can create a short awareness message (slogan) to accompany the post, such as:

“Engineering connects worlds: your bridge starts here.”

Don't forget to take a photo of your experience and share it with us!



[LinkedIn](#)



[Instagram](#)



[X](#)



PROJECT EVALUATION

Activity Objectives	Key Competences (EU)	Evaluation Criteria
Understand the principles of forces and balance applied to structures.	Mathematical competence and basic skills in science and technology.	Correctly identifies the concepts of strength, balance and resistance during construction.
Apply proportions, estimates and measurements in planning and execution.	Mathematical competence.	Correctly uses measurements and proportions in the design and construction of the bridge.
Develop creative thinking and efficient design strategies.	Sense of initiative and entrepreneurial spirit.	Proposes creative, innovative solutions and realistic to the challenge.
Work as a team, promoting gender-balanced leadership.	Social and civic skills; learn to learn.	Actively participates in decisions and respects the equitable division of roles and responsibilities within the group.
Recognize the contribution of women in engineering and architecture.	Cultural awareness and expression; competence in gender awareness and expression.	Refers to or represents female models in the presentation or final reflection of the activity.
Communicate results clearly, using technical and visual language.	Digital competence and communication in mother tongue.	Presents results clearly through oral, written and/or visual language (e.g. graph, video, poster).

BIBLIOGRAPHY AND REFERENCES

- <https://www.youtube.com/watch?v=IDIGH3JoGns>
- https://en.wikipedia.org/wiki/Emily_Warren_Roebling
- <https://www.zaha-hadid.com/>
- https://www.instagram.com/steambrace_eu/
- <https://www.linkedin.com/company/steambrace-project/>

